Energy efficient operations and the commitment to CHP

Sharon L. Nolen, PE, CEM
Eastman Chemical Company
Manager, Worldwide Energy Program
Agenda

- Background of Eastman Chemical Company
- Commitment to CHP
- Energy management program
Who we are

- A global specialty chemical company headquartered in Kingsport, Tennessee
- Approximately 15,000 employees and over 50 manufacturing sites around the globe
- Serving customers in approximately 100 countries
- A company dedicated to environmental stewardship, social responsibility and economic growth
- 2014 revenue of $9.5 billion

2014 World’s Most Ethical Company® by the Ethisphere® Institute

2014 ENERGY STAR® Partner of the Year Sustained Excellence following 2012 and 2013 ENERGY STAR Partner of the Year

#7 in Bloomberg Businessweek Top 50

2013 Secretary of Defense Employer Support Freedom Award

2013 Responsible Care® Company of the Year – large category
Our manufacturing locations

- Corporate headquarters
- Eastman Manufacturing

Anniston, AL  
Antwerp, Belgium  
Canoga Park, CA  
Chesterfield, MD  
Chicago, IL  
Columbia, SC  
Dresden, Germany  
Fengxian, China  
Fieldale, VA  
Franklin, VA  
Ghent, Belgium  
Hefei, China  
Indianapolis, IN  
Itupeva, Brazil  
Jefferson, PA  
Jurong Island, Singapore  
Kashima, Japan  
★ Kingsport, TN  
Kohtla-Järve, Estonia  
Kuantan, Malaysia  
Lemoyne, PA  
Leuna, Germany  
Linden, NJ  
Longview, TX  
Martinsville, VA  
Middelburg, The Netherlands  
Monongahela, PA  
Nanjing, China  
Newport, Wales  
Nienburg, Germany  
Oulu, Finland  
Pace, Florida  
Santo Toribio, Mexico  
São Paulo Mauá, Brazil  
Sauget, IL  
Sete, France  
Shenzhen, China  
Springfield, MA  
St Gabriel, Louisiana  
Sun Prairie, WI  
Suzhou, China  
Texas City, TX  
Trenton, MI  
Ulsan, Korea  
Uruapan, Mexico  
Watertown, NY  
Workington, UK  
Wuhan, China  
Yixing City, China  
Zibo, China
Diversified product lines & technologies

2014 sales revenue by market*

16% Building & Construction
18% Transportation
15% Consumables
3% Electronics
15% Tobacco
11% Industrial Chemicals & Processing
2% Agriculture
3% Other
3% Energy, Fuels & Water
7% Durables Goods
7% Health & Wellness

*Does not include revenue from Taminco or Commonwealth Laminating and Coating
A long history of creative thinking and industry solutions
Self sufficiency mindset

- CHP since the 1920’s
- Incineration complex
- Hazardous and non-hazardous landfills
- Wastewater treatment
Commitment to CHP
Eastman’s first encounter with CHP
Kingsport, Tennessee plant

- Eastman Chemical Company’s Tennessee Operations (TNO) is one of the largest chemical manufacturing sites in North America, covering approximately 900 acres
- This facility produces a variety of chemicals, fibers, and plastics and also serves as the worldwide headquarters for Eastman Chemical Company
- The facility began operating its first CHP system in 1920’s and has continued adding to the system until its most recent expansion in 1993
- TNO’s experience with CHP predates the construction of a reliable electric grid in the Kingsport area
- When it first came online, the CHP system was the only reliable source of electricity for the facility
CHP at the Kingsport, TN plant

- Continuous use (only 5 complete plant shutdowns for >99.9% reliability)
- Consists of seventeen boilers and nineteen steam turbines
- Electric generating capacity of 200 MW
- Average steam load of ~3,600,000 lb/hr at a range of pressures in order to meet the thermal needs of the facility
CHP at the Kingsport, TN plant

Steam details

- CHP provides 100% of the steam used by TNO
- Natural gas and coal are used to fuel the boilers
- Three boilers are used as back-ups
- Most steam is delivered to the turbines at a pressure of 1450 psig
- After exiting the turbines, ~3,000,000 lb/hr of steam is supplied to the facility at 600 psig, 100 psig, and 15 psig
- Steam is used for process heating, powering air compressors and refrigeration machines, and space heating inside the facility (~550 buildings)
Benefits of CHP at the TNO site:

- CHP total efficiency: >70%
- Avoided CO₂ emissions: 358,000 tons/yr (equivalent to emissions from the generation of electricity used by more than 44,000 homes)
- Yearly savings: $~45M
- Moreover, by generating electricity on site, the system reduces demands on existing transmission and distribution infrastructure

Two other Eastman sites currently make use of CHP

- Longview, Texas
- Indian Orchard, MA

92% of Eastman’s worldwide production occurs at sites with co-generation

Enables a source energy reduction of several trillion Btu’s each year
ENERGY STAR® Combined Heat and Power Award

- CHP systems can qualify for an award of merit, the ENERGY STAR® CHP Award, if they demonstrate considerable fuel and emissions savings over comparable, state-of-the-art separate heat and power generation.

- On September 20th, 2014, the U.S. Environmental Protection Agency (EPA) recognized Eastman with an ENERGY STAR® Combined Heat and Power (CHP) Award for excellence in combined heat and power operations at its Kingsport site.

- Shows that it’s difficult to beat the efficiency gains delivered by a CHP system (even one >80 years old).
Energy management program
Energy management program

- CHP provides a great foundation for efficient operations, but a strong, active energy management program can help optimize energy use.

- Standard energy program initiatives have been in place for many years leading to a “good” program:
  - On-site energy training and assessments
  - Programs in place at the largest sites to:
    - Improve insulation
    - Improve lighting efficiency
    - Reduce steam leaks
  - Capital allocated to improve sub-metering
  - ACC energy efficiency awards for 17 consecutive years
Cause for change

In 2010, Eastman decided to pursue an aspirational goal to inspire radical improvement

- Eastman made a public pledge to the DOE Better Buildings, Better Plants Program to reduce energy intensity with a baseline of 2008, the year Eastman became an ENERGY STAR® Partner
- The existing program would fall short of what was needed to meet this ambitious goal

Suddenly, good was not good enough
Executive level support

- Executive level support is needed for a successful energy program

As Eastman’s energy program was revamped in 2010, an Executive Steering Team was formed
  - Included three Executive Team members
  - Quarterly meetings with the corporate energy program manager
  - High-level support and direction led to two important program enhancements
    - Capital project funding
    - Enhanced data analysis
Executive level support
Capital project funding

- In 2010, no capital money was allocated specifically for energy efficiency projects
- Many good energy projects simply fell below the approval level when competing with other projects
- When shown a list of projects that had not been funded, the Steering Team immediately funded $4.2M of energy projects
- Within two years, the capital energy budget grew to $8M/year
- Led to increased interest in the energy program
  - Manufacturing areas recognized the additional avenue for funding
  - The energy team became a welcomed partner
Executive level support
Enhanced data analysis

- As the executive team members became increasingly involved, they challenged the energy team to develop quantitative information to:
  - Identify the major items affecting the measure
  - Assess the magnitude of each item
  - Evaluate progress towards the goal

- Efforts resulted in a tool to quantify the gap between the forecasted impact of current plans and the energy intensity goal
Strategy and principles

- Strategy utilizes five key components:
  - Measures
  - External resources
  - Awareness
  - Initiatives
  - Projects

- Three guiding principles were developed as a reference to ensure that decisions made related to the energy program are consistent with the intended direction:
Guiding Principles

Ensure the Accuracy of Utility Information
- Creates a basis for sound business decisions
- Required for accurate reporting and life cycle assessments

Maximize Operating Efficiency
- Reduces energy usage economically
- Typically improves the reliability of equipment

Incorporate Energy Efficiency in Capital Investments
- Improves lifetime equipment costs
- Positively impacts carbon emissions
Principles
Ensure the accuracy of utility information

- Site management at the largest site proactively decided to add meters in strategic locations
- Energy surveys check the accuracy of allocated costs and correct placement of meters
- Modelling efforts have been able to predict energy use on a product level

Manufacturing managers are more than willing to make good energy decisions – they just need the right information to enable them to do so
Principles
Maximize operating efficiency

- Rotating equipment is tested to ensure that each piece of equipment is operating at the best efficiency point on the operational curve
- Equipment includes turbines, pumps, chillers, and compressors
- Equipment that is not performing as designed is scheduled for maintenance to restore optimum performance
Principles

Incorporate energy efficiency in capital investments

- Most opportunities for energy efficient equipment and processes occur during the design stage versus retrofits.
- According to the DOE’s sourcebook for improving motor and drive system performance, the total life-cycle cost makeup of an electric motor is:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percent of Life-Cycle Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>96%</td>
</tr>
<tr>
<td>Capital cost</td>
<td>3%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>1%</td>
</tr>
</tbody>
</table>

- Energy efficiency considerations can have a large effect on the total ownership costs related to machine drives.
Strategy Measures

- Critical to have a well-defined, auditable measure with meaningful goals
- Eastman’s existing measure (MMBtu/kkg) had to be improved in several respects to meet this criteria
  - Definition – Standardized and communicated
  - Frequency – Increased from annually to monthly
  - Automation – Reduced the opportunity for human error
  - Auditability – Reported externally in Eastman’s Sustainability Report
Strategy
External resources

- ENERGY STAR®
  - ENERGY STAR Guidelines for Energy Management used to identify gaps in the existing program
  - ENERGY STAR Partners have the opportunity to benchmark with other companies and share best practices
  - Partner website and webinars provide insight
  - Review of the existing corporate energy program by knowledgeable, outside individuals
    - An assigned mentor (an energy manager from another company)
    - Technical Advisor

- DOE
  - On-site training
  - On-site assessments of utility systems

Both ENERGY STAR and the DOE hold meetings where partner companies share information both through formal presentations and networking opportunities.
Strategy
Employee awareness

- Energy program was originally only project-focused
- ENERGY STAR helped expand the program to include employee engagement and awareness
  - Posters, brochures, children’s activity books, and displays are available for ENERGY STAR partners
  - ENERGY STAR is a well-recognized and positively perceived brand
- Energy fairs
  - Held first fair in 2011 after visiting another company’s fair
  - Used ENERGY STAR resources
  - Local utilities and retail stores manned booths showcasing energy efficiency products
Strategy
Employee awareness

- **Green Teams**
  - Geared toward sharing information with employees that have personal interests in preserving the environment
  - ENERGY STAR provides a Green Team Checklist with the needed framework
  - Monthly newsletters with ideas and events

- **ENERGY STAR Pledge**
  - Designed for individuals to pledge energy savings at home
  - Distributed via email, company newsletter, and promotional events
  - Eastman was a Top 5 pledge driver in 2012 and 2013

- **ENERGY STAR Portfolio Manager**
  - Enables office employees to benchmark building energy use
  - Obtained first ENERGY STAR Certified Building in 2013 after decreasing energy usage in a building by 57%
  - Internal competition between similar buildings increases enthusiasm
Strategy

Energy initiatives

- Sharing of best practices
  - One manufacturing area took a different approach to steam leak repair that led to a 98% reduction in leaks over ten years
  - Their approach has been recognized internally as a best practice and incorporated into the program

- Potential identified for a centralized, standardized approach for other initiatives
  - Steam traps
  - Motors
  - HVAC

- Evaluation
  - Questionnaire to assess the progress of each site in each area
  - Results serve to identify common areas of concern, needs for improvements, and best practices at individual sites for sharing
Strategy

Energy projects

- Database of potential projects is continually updated
- Best projects are identified
- Typical projects
  - Upgrades to more energy-efficient equipment
  - Heat recovery opportunities
- Project ideas are usually process-specific, but there is some potential to find common opportunity across the company
Link with other initiatives

Compliment the tangible benefits of energy projects with other corporate initiatives to gain additional support

- **Safety** – More efficient technology can result in:
  - Less lumen degradation → safer working conditions
  - Longer lamp life → employees will be working fewer hours at elevated heights

- **Productivity** – Group relamping results in more efficient use of labor (and more immediate energy savings)

- **Sustainability**
  - Sustainability is more closely connected to the businesses while the energy program is more closely tied to manufacturing
  - The sharing of connections and insights has proven valuable
  - The Executive Steering Team also links to the company’s Sustainability Council with additional members of top management
Consistency

- The gas shortages in the 1970’s sparked several important changes at Eastman, including:
  - Investment in coal gasification
  - Appointment of Eastman’s first energy manager

- Interest and attention to energy efficiency varied over the next several decades with energy availability and cost
  - At times, there was a full-time energy manager reporting directly to site management
  - At times, there was capital funding available for energy projects
  - These good practices were not sustained consistently over time

- It is likely that Eastman’s approach to efficiency will be much more consistent in the future as it is a key element of Eastman’s sustainability commitment
Summary

- CHP systems are not typically the lowest upfront capital cost approach to supply energy, but they are clear winners when evaluated on a life cycle cost basis.
- CHP systems can provide a stable and advantaged energy position in the face of volatile fuel and electricity costs for decades.
- CHP provides a great foundation for efficient operations, but a strong, active energy management program can help optimize energy use.
- While energy efficiency in industry may be perceived as purely a technical challenge, a robust energy program must broadly seek support and input from many internal organizations with engagement of employees at all levels.
Questions?

Be a star.
Help the planet.